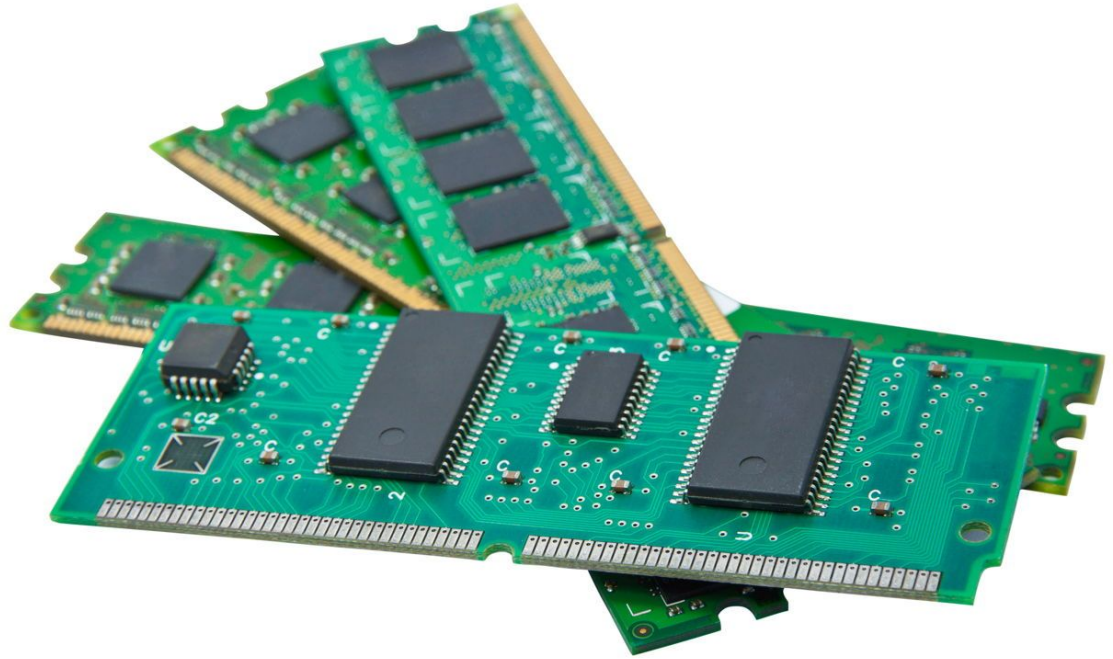


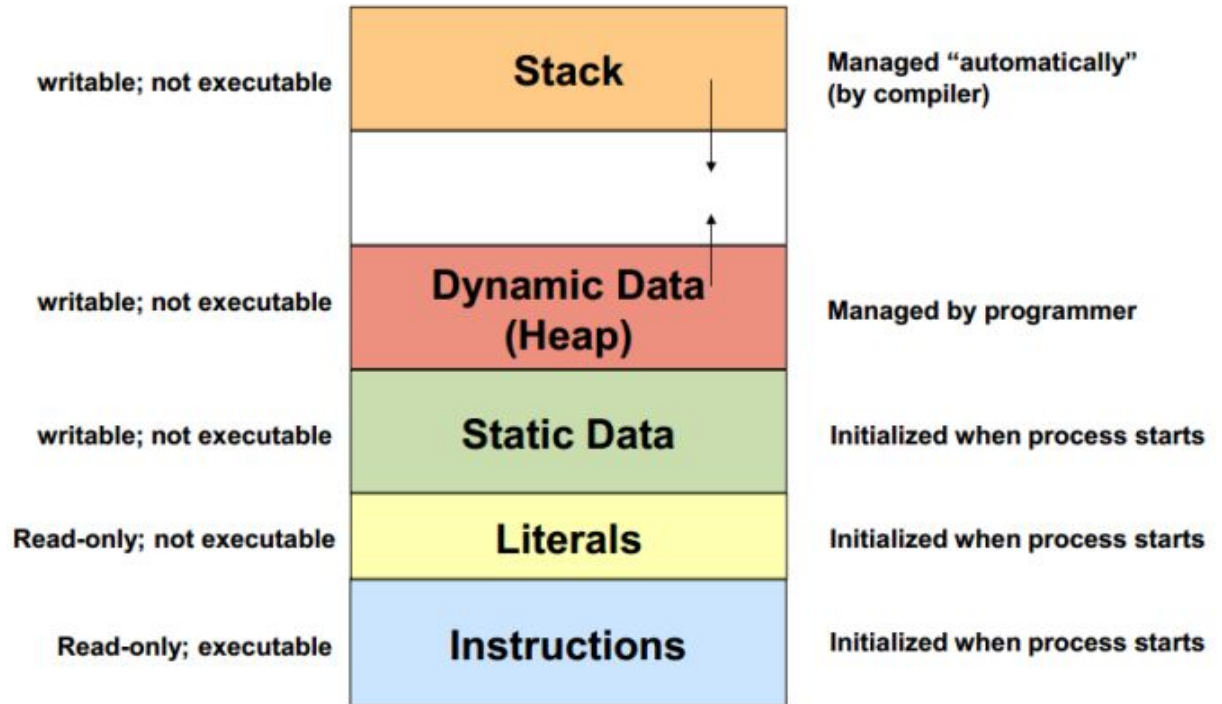
[illegible]

Memory



Memory

Names not important



Objects

- Data and objects are just chunks of memory
- When you construct an object, the computer gives you an appropriately sized chunk of memory
 - The fields are just specific locations within a chunk to store data
- This is why we need the difference between equality of value and equality of identity
 - **Equal value:** memory chunks store the same values
 - **Equal identity:** same chunk of memory
- By creating objects, you are making your program use more memory

Creating Objects

- Every time an object is created, it takes up a bit of memory
 - This can build up over time
 - If an object is not referenced, it will get **garbage collected**.
-
- Natural question, who would ever create this many objects?
 - You did on HW4!

Using pickle to store object in a file

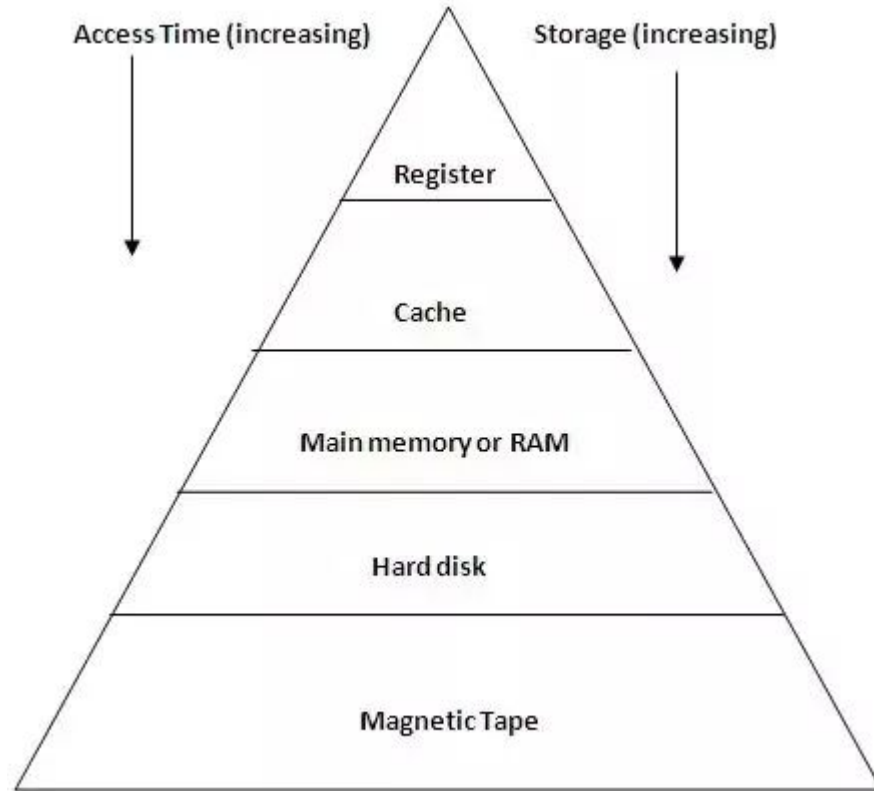


VS Code

Memory Hierarchy

- The memory we have been talking about is volatile memory
 - If you shut your computer down, it all disappears
- It's great because it's relatively fast and can store a moderate amount of data (~16GB)
- However it's not the fastest nor can it store the most data

Memory Hierarchy



Disk Drive



Paging

- When working with big data, it might be the case that your data doesn't fit in memory
- In this case, your computer will send big chunks of memory to disk until it's needed later
- This can cause huge slow downs in your program since reading/writing to disk is generally slow

General Takeaways

- Don't store references to data you don't need
 - Restrict global variables
- Keep things local
 - Don't iterate through data in random order
- When developing, use a small random sample of your data so you don't have to work with the whole thing.